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Report on the individual review of the annual submission of Liechtenstein submitted in 2014*

* In the symbol for this document, 2014 refers to the year in which the inventory was submitted, and not to the year of publication.

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I. Introduction and summary

1. This report covers the review of the 2014 annual submission of Liechtenstein, coordinated by the UNFCCC secretariat, in accordance with the "Guidelines for review under Article 8 of the Kyoto Protocol" (decision 22/CMP.1) (hereinafter referred to as the Article 8 review guidelines). The review took place from 15 to 20 September 2014 in Bonn, Germany, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalists – Mr. Newton Paciornik (Brazil) and Ms. Melissa Weitz (United States of America); energy – Mr. Leonidas Girardin (Argentina), Ms. Gherghita Nicodim (Romania) and Mr. Anand Sookun (Mauritius); industrial processes and solvent and other product use – Mr. Erhan Unal (Turkey) and Ms. Sina Wartmann (Germany); agriculture – Mr. Paul Duffy (Ireland), Mr. Bernard Hyde (Ireland) and Mr. Yuriy Pyrozhenko (Ukraine); land use, land-use change and forestry (LULUCF) – Mr. Valentin Bellassen (France), Mr. Zoltan Somogyi (Hungary) and Ms. Diana Vargas (Colombia); and waste – Ms. Maryna Bereznytska (Ukraine) and Ms. Riitta Pipatti (Finland). Ms. Bereznytska and Mr. Paciornik were the lead reviewers. The review was coordinated by Mr. Roman Payo (UNFCCC secretariat).

2. In accordance with the Article 8 review guidelines, a draft version of this report was sent to the Government of Liechtenstein, which provided comments that were considered and incorporated, as appropriate, into this final version of the report. All encouragements and recommendations in this report are for the next annual submission, unless otherwise specified.

3. All recommendations and encouragements included in this report are based on the expert review team's (ERT's) assessment of the 2014 annual submission against the Article 8 review guidelines. The ERT has not taken into account the fact that Parties will prepare the submissions due by 15 April 2015 using the revised "Guidelines for the preparation of national communications by Parties include in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories" adopted through decision 24/CP.19. Therefore, when preparing the next annual submissions, Parties should evaluate the implementation of the recommendations and encouragements in this report, in the context of those guidelines.

4. In 2012, the main greenhouse gas (GHG) emitted by Liechtenstein was carbon dioxide (CO_2), accounting for 83.7 per cent of total GHG emissions[1] expressed in CO_2 equivalent (CO_2 eq), followed by methane (CH_4) (7.1 per cent) and nitrous oxide (N_2O) (5.5 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 3.7 per cent of the overall GHG emissions in the country. The energy sector accounted for 84.7 per cent of total GHG emissions, followed by the agriculture sector (10.3 per cent), the industrial processes sector (3.7 per cent), the waste sector (0.9 per cent) and the solvent and other product use sector (0.4 per cent). Total GHG emissions amounted to 225.30 Gg CO_2 eq and decreased by 1.5 per cent between the base year[2] and 2012. The ERT concluded that the description in the national inventory report (NIR) of the trends for the different gases and sectors is reasonable.

[1] In this report, the term "total GHG emissions" refers to the aggregated national GHG emissions expressed in terms of carbon dioxide equivalent excluding LULUCF, unless otherwise specified.

[2] "Base year" refers to the base year under the Kyoto Protocol, which is 1990 for all gases. The base year emissions include emissions from source categories included in Annex A to the Kyoto Protocol only.

5. Tables 1 and 2 show GHG emissions from source categories included in Annex A to the Kyoto Protocol (hereinafter referred to as Annex A sources), emissions and removals from the LULUCF sector under the Convention and emissions and removals from activities under Article 3, paragraph 3, and, if any, elected activities under Article 3, paragraph 4, of the Kyoto Protocol (KP-LULUCF), by gas and by sector and activity, respectively.

6. Information to be included in the compilation and accounting database can be found in annex I to this report.

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

7. The 2014 annual submission was submitted on 15 April 2014; it contains a complete set of common reporting format (CRF) tables for the period 1990–2012 and an NIR. Liechtenstein also submitted the information required under Article 7, paragraph 1, of the Kyoto Protocol, including information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, accounting of Kyoto Protocol units, changes in the national system and in the national registry and the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol. The standard electronic format (SEF) tables were submitted on 15 April 2014. The annual submission was submitted in accordance with decision 15/CMP.1.

8. Liechtenstein submitted revised emission estimates on 3 November 2014 in response to the list of potential problems and further questions raised by the ERT (see paras. 59, 67, 68, 87, 91, 92, 100 and 101 below). The values used in this report are those submitted by Liechtenstein on 3 November 2014.

9. The list of other materials used during the review is provided in annex II to this report.

2. Questions of implementation raised in the 2013 annual review report

10. The ERT noted that no questions of implementation were raised in the 2013 annual review report.

Table 1

Greenhouse gas emissions from Annex A sources and emissions/removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol by gas, base year[a] to 2012

			Gg CO_2 eq								*Change (%)*
		Greenhouse gas	*Base year*	*1990*	*1995*	*2008*	*2009*	*2010*	*2011*	*2012*	*Base year 2012*
Annex A sources		CO_2	200.81	200.81	205.65	223.35	209.01	194.12	179.99	188.56	-6.1
		CH_4	14.58	14.58	13.55	15.89	15.61	15.19	15.56	15.88	8.9
		N_2O	13.27	13.27	13.08	12.54	12.40	12.36	12.52	12.48	-6.0
		HFCs	0.00009	0.00009	0.84	7.19	7.43	7.87	7.98	8.33	8 773 983.9
		PFCs	NA, NO	NA, NO	0.00003	0.07	0.06	0.06	0.06	0.05	NA
		SF_6	NA, NO	NA, NO	NA, NO	0.36	0.14	0.02	0.01	0.0005	NA
KP-LULUCF	Article 3.3[b]	CO_2				3.69	3.74	3.81	3.89	3.97	
		CH_4				NO	NO	NO	NO	NO	
		N_2O				NO	NO	NO	NO	NO	
	Article 3.4[c]	CO_2	NA			NA	NA	NA	NA	NA	NA
		CH_4	NA			NA	NA	NA	NA	NA	NA
		N_2O	NA			NA	NA	NA	NA	NA	NA

Abbreviations: Annex A sources = source categories included in Annex A to the Kyoto Protocol, KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NA = not applicable, NO = not occurring.

[a] The base year for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for all gases. The base year for cropland management, grazing land management and revegetation under Article 3, paragraph 4, of the Kyoto Protocol is 1990. For activities under Article 3, paragraph 3, of the Kyoto Protocol and forest management under Article 3, paragraph 4, only the inventory years of the commitment period must be reported.

[b] Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation.

[c] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation.

Table 2
Greenhouse gas emissions by sector and activity, base year[a] to 2012

			Gg CO_2eq								*Change (%)*
		Sector	*Base year*	*1990*	*1995*	*2008*	*2009*	*2010*	*2011*	*2012*	*Base year–2012*
Annex A sources		Energy	201.47	201.47	207.10	225.48	211.12	196.25	182.10	190.74	–5.3
		Industrial processes	0.00009	0.00009	0.84	7.62	7.64	7.96	8.05	8.38	8 825 057.8
		Solvent and other product use	2.01	2.01	1.54	0.93	0.92	0.91	0.91	0.91	–54.5
		Agriculture	23.36	23.36	21.92	23.30	23.13	22.68	23.12	23.26	–0.4
		Waste	1.83	1.83	1.71	2.07	1.85	1.84	1.94	2.01	10.1
		LULUCF	NA	–9.46	–9.64	–7.38	–7.24	–7.14	–7.03	–6.91	NA
		Total (with LULUCF)	**NA**	**219.21**	**223.48**	**252.02**	**237.42**	**222.49**	**209.10**	**218.39**	**NA**
		Total (without LULUCF)	**228.67**	**228.67**	**233.12**	**259.39**	**244.66**	**229.63**	**216.12**	**225.30**	**–1.5**
		Other[b]	NA	NO	NO	NO	NO	NO	NO	NO	NA
KP-LULUCF	Article 3.3[c]	Afforestation and reforestation				–0.21	–0.22	–0.20	–0.18	–0.17	
		Deforestation				3.90	3.96	4.01	4.07	4.13	
		Total (3.3)				**3.69**	**3.74**	**3.81**	**3.89**	**3.97**	
	Article 3.4[d]	Forest management				NA	NA	NA	NA	NA	
		Cropland management	NA			NA	NA	NA	NA	NA	NA
		Grazing land management	NA			NA	NA	NA	NA	NA	NA
		Revegetation	NA			NA	NA	NA	NA	NA	NA
		Total (3.4)	**NA**			**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Abbreviations: Annex A sources = source categories included in Annex A to the Kyoto Protocol, KP-LULUCF = LULUCF emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, LULUCF = land use, land-use change and forestry, NA = not applicable, NO = not occurring.

[a] The base year for Annex A sources is the base year under the Kyoto Protocol, which is 1990 for all gases. The base year for cropland management, grazing land management and revegetation under Article 3, paragraph 4, of the Kyoto Protocol is 1990. For activities under Article 3, paragraph 3, of the Kyoto Protocol and forest management under Article 3, paragraph 4, only the inventory years of the commitment period must be reported.

[b] Emissions/removals reported in the sector other (sector 7) are not included in Annex A to the Kyoto Protocol and are therefore not included in national totals.

[c] Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation.

[d] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation.

3. Overall assessment of the inventory

11. Table 3 contains the ERT's overall assessment of the annual submission of Liechtenstein. For recommendations for improvements for specific categories, please see the paragraphs cross-referenced in the table.

Table 3
The expert review team's overall assessment of the annual submission

Issue	*Expert review team assessment*	*General findings and recommendations*
The ERT's findings on completeness		
Annex A sources[a]	Complete	Mandatory: none Non-mandatory: none
Land use, land-use change and forestry[a]	Complete	Mandatory: none Non-mandatory: none
KP-LULUCF	Complete	
The ERT's findings on recalculations and time-series consistency		
Transparency of recalculations	Sufficiently transparent	The quantified information is not presented at the key category level. The ERT reiterates the recommendation made in the previous review report that Liechtenstein provide the impact of the recalculations at the key category level in chapter 10 of its NIR
Time-series consistency	Sufficiently consistent	Please see paragraphs 31 and 31 below for category-specific findings
The ERT's findings on QA/QC procedures	Sufficient	Liechtenstein has elaborated a QA/QC plan and has implemented tier 1 QA/QC procedures in accordance with that plan Please see paragraphs 62 and 69 below for category-specific recommendations In particular, the ERT recommends that Liechtenstein implement additional QC procedures to avoid mistakes or discrepancies between the CRF tables and the NIR (see paras. 32, 37, 39 and 62 below)
The ERT's findings on transparency	Sufficiently transparent	Please see paragraphs 14, 35, 39, 47, 50, 61, 63, 66, 71, 72, 77, 81–83 and 88 below for category-specific recommendations

Abbreviations: Annex A sources = source categories included in Annex A to the Kyoto Protocol, CRF = common reporting format, ERT = expert review team, KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NIR = national inventory report, QA/QC = quality assurance/quality control.

[a] The assessment of completeness by the ERT considers only the completeness of reporting of mandatory categories (i.e. categories for which methods and default emission factors are provided in the Intergovernmental Panel on Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* or the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*).

12. As recommended in previous review reports, Liechtenstein has included in the NIR (section 1.6.1.6 on quality assurance (QA) review procedures) information from the Swiss internal review (part of the Swiss QA procedures) for the industrial processes sector but did not elaborate on the review's findings or planned additional reviews. In response to questions raised by the ERT during the review, Liechtenstein stated that Switzerland has plans for future QA procedures for its energy and agriculture sectors that will also have implications for the national inventory of Liechtenstein. The ERT recommends that Liechtenstein include the findings of the implemented reviews in its NIR.

4. Description of the institutional arrangements for inventory preparation, including the legal and procedural arrangements for inventory planning, preparation and management

Inventory planning

13. The NIR described the national system for the preparation of the inventory. As indicated by Liechtenstein in its NIR, there were no changes to the inventory planning process. The description of the inventory planning process, as contained in the report of the individual review of the annual submission of Liechtenstein submitted in 2013,[3] remains relevant.

14. The Party's quality assurance/quality control (QA/QC) plan is generally in line with the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance), but the improvement development plan provided in the NIR (chapter 1.3.3, page 29 and annex A8.3, page 293) is not fully consistent and is not up to date. In particular, the ERT considers that the text "implemented in submission 2014", included in the tables, is not very helpful without cross-references to the section and page where the information is revised and presented and a brief description of the measures implemented is provided. The ERT reiterates the recommendation made in the previous review report that Liechtenstein revise its improvement development plan by including all the recommendations made in previous review reports, together with transparent information on how each recommendation was taken into consideration and the intended implementation date of these recommendations.

15. As recommended in the previous review report, Liechtenstein improved the description in the NIR (chapter 1.3) of the process of final approval of the inventory submission. The ERT commends Liechtenstein for this improvement.

Inventory preparation

16. Table 4 contains the ERT's assessment of Liechtenstein's inventory preparation process. For improvements related to specific categories, please see the paragraphs cross-referenced in the table.

17. A tier 2 key category analysis was performed in addition to the tier 1 key category analysis. However, in CRF table 7 a category is marked as key if it has been identified as key by either of the two approaches. In addition, in the sectoral chapters of the NIR the key categories mentioned are those identified by the tier 1 approach only. The IPCC good practice guidance states that if both the tier 1 and the tier 2 analysis have been performed, it is good practice to use the results of the tier 2 analysis. The ERT recommends that Liechtenstein consistently apply the approach set out in the IPCC good practice guidance.

[3] FCCC/ARR/2013/LIE, paragraphs 9–12.

Table 4
Assessment of inventory preparation by Liechtenstein

Issue	*ERT assessment*	*ERT findings and recommendations*
Key category analysis		
Was the key category analysis performed in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF?	No	Level and trend analysis performed, including and excluding LULUCF See paragraph 17 above
Approach followed?	Both tier 1 and tier 2	The tier 2 approach was implemented for the first time
Were additional key categories identified using a qualitative approach?	No	
Has Liechtenstein identified key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol following the guidance on establishing the relationship between the activities under the Kyoto Protocol and the associated key categories in the UNFCCC inventory?	Yes	In CRF table NIR-3 the activity forest management is identified as key. However, Liechtenstein did not elect any activity under Article 3, paragraph 4, of the Kyoto Protocol. The ERT recommends that Liechtenstein do not include activities under Article 3, paragraph 4, of the Kyoto Protocol in its key category analysis
Does Liechtenstein use the key category analysis to prioritize inventory improvements?	Yes	The use of the key category analysis to prioritize inventory improvements is not mentioned in the NIR. The ERT recommends that Liechtenstein describe in the NIR how it uses key categories to prioritize inventory improvements
Assessment of uncertainty analysis		
Approach followed?	Both tier 1 and tier 2 (NIR section 1.7)	The tier 2 approach was implemented for the first time in the 2014 submission
Was the uncertainty analysis carried out in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF?	Yes	Please see paragraphs 77 and 89 below for category-specific findings
Quantitative uncertainty (including LULUCF)	Level = 6.5% (tier 1), 5.8% (tier 2) Trend = 6.7% (tier 1), 7.7% (tier 2)	
Quantitative uncertainty (excluding LULUCF)	Level = 5.4% (tier 1), 4.6% (tier 2) Trend = 6.3% (tier 1), 7.8% (tier 2)	

Abbreviations: ERT = expert review team, CRF = common reporting format, IPCC good practice guidance = the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, IPCC good practice guidance for LULUCF = IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*, LULUCF = land use, land-use change and forestry, NIR = national inventory report.

Inventory management

18. There were no changes to the inventory management process carried out by Liechtenstein for the 2014 annual submission, as indicated by the Party. The description of the inventory management process, as contained in the report of the individual review of the annual submission of Liechtenstein submitted in 2013,[4] remains relevant.

5. Follow-up to previous reviews

19. Liechtenstein has implemented many of the recommendations made by the ERTs of previous reviews. Transparency of the information in the NIR has substantially improved, particularly for the energy sector. The ERT commends Liechtenstein for these improvements. Liechtenstein includes in annex A8.3 (page 293) of the NIR tables the location of information on the follow-up of the recommendations. However, the tables are neither complete nor up to date and the information is not transparent (see para. 14 above).

20. Recommendations from previous reviews that have not yet been implemented, as well as issues the ERT identified during the 2014 annual review, are discussed in the relevant sectoral chapters of the report and in table 9 below.

B. Energy

1. Sector overview

21. The energy sector is the main sector in the GHG inventory of Liechtenstein. In 2012, emissions from the energy sector amounted to 190.74 Gg CO_2 eq, or 84.7 per cent of total GHG emissions. Since 1990, emissions have decreased by 5.3 per cent. The key drivers for the fall in emissions are the categories manufacturing industries and construction and other sectors, for which GHG emissions decreased by 31.6 and 9.5 per cent, respectively, in this period (see para. 22 below). Within the sector, 43.2 per cent of the emissions were from transport, followed by 41.7 per cent from other sectors, 13.0 per cent from manufacturing industries and construction and 1.5 per cent from energy industries. The remaining 0.5 per cent was fugitive emissions from fuels. Emissions from energy (other) are reported as "NO" (not occurring).

22. Several factors explain the emission trend over time. Emissions from the energy sector increased by 17.6 per cent between 1990 and 2006 as a result of increases in population and employment over the past 20 years (the latter of which attracted commuters from other countries) amounting to 25.7 and 84.3 per cent, respectively, as well as an increase in road vehicle-kilometres. Emissions decreased in 2007 because of weather conditions (a warm winter) and high energy costs and then further decreased between 2008 and 2011. The trend between 2008 and 2011 can be attributed to the import of steam from a waste incineration plant situated in Switzerland and the downward trend of 'tank tourism'[5] for road transport. In 2011, emissions from the energy sector were the lowest in the entire time series 1990–2012 (a 9.6 per cent decrease compared with 1990). Emissions from the energy sector increased by 4.7 per cent between 2011 and 2012 because there were more heating degree days.

23. Liechtenstein has made recalculations between the 2013 and 2014 annual submissions for this sector. The recalculations were adequately explained. The most significant recalculations between the 2013 and 2014 annual submissions resulted from the

[4] FCCC/ARR/2013/LIE, paragraph 14.

[5] Tank tourism is a phenomenon whereby motorists travel to a neighbouring country where fuel prices are cheaper than in their home country to refuel their vehicles.

correction of the emission factor (EF) (i.e. the calorific value for natural gas, which is reported by the energy statistics as net and not gross value, as had been assumed in previous submissions). Thus, recalculations were performed in the following categories:

(a) Manufacturing industries and construction: the recalculations increased emissions by 2.9 per cent and 15.5 per cent for 1990 and 2011, respectively;

(b) Other sectors: the recalculations decreased emissions by 1.0 per cent and 4.9 per cent for 1990 and 2011, respectively;

(c) Fugitive emissions from oil and natural gas: the recalculations decreased emissions by 3.6 per cent and 2.6 per cent for 1990 and 2011, respectively.

24. The recalculations were made in response to recommendations made in the 2013 annual review report following changes in activity data (AD) and the EF for natural gas, and in order to rectify the identified error (see para. 23 above). Compared with the 2013 annual submission, the recalculations decreased emissions in the energy sector for 2011 by 4.98 Gg CO_2 eq (2.7 per cent) and decreased total national emissions by 2.2 per cent.

25. As did the previous ERT, the current ERT commends the Party for its ongoing efforts concerning the continuous improvement in transparency of the NIR for the energy sector. Most of the recommendations made in the previous review reports have been taken into consideration and there are further transparency improvements, such as: clarification of the calorific values for natural gas (net and not gross calorific values, as incorrectly reported and used in emission estimates in previous submissions); consistency between the CRF tables 1.A(c) and the NIR concerning the difference between the reference approach and the sectoral approach related to energy consumption (NIR table 3-10, page 84); correction of notation keys in CRF table 1.A(a)s3 (for navigation, for other liquid fuels, the notation key "NA" (not applicable) was replaced by "NO"); and confirmation that biofuels are absent from imported gasoline and diesel fuels.

26. In response to questions raised by the ERT during the review, Liechtenstein provided information on further work to improve the quality of the inventory and the NIR, including: reallocation of the categories in the NIR to ensure consistency with the CRF tables (see paras. 37–39 below); reallocation of emissions from other (manufacturing industries and construction; see para. 41 below); splitting fuel consumption between domestic and international under aviation (see paras. 31–31 below); transparency of the estimates for fugitive emissions from the natural gas transmission and distribution network and other leakage at the end-users under industry and residential (see paras. 49 and 50 below); and new data related to the non-energy use of fuel in road transportation (see paras. 33 and 42 below). Data reported in the CRF tables and in the NIR are not always consistent (see paras. 32, 37, 39 and 44 below). The ERT recommends that the Party implement additional QC procedures to avoid mistakes or discrepancies between the CRF tables and the NIR.

2. Reference and sectoral approaches

27. Table 5 provides a review of the information reported under the reference approach and the sectoral approach, as well as comparisons with other sources of international data. Issues identified in table 5 are more fully elaborated in paragraphs 28–33 below.

Table 5
Review of reference and sectoral approaches

Issue	*Expert review team assessment*	*Paragraph cross-references*
Difference between the reference approach and the sectoral approach for 2012	Energy consumption: no difference CO_2 emissions: 0.07 Gg CO_2, 0.04%	
Are differences between the reference approach and the sectoral approach adequately explained in the NIR and the CRF tables?	Yes	
Are differences with international statistics adequately explained?	Not applicable	See para. 29 below
Is reporting of bunker fuels in accordance with the UNFCCC reporting guidelines?	Yes	
Is reporting of feedstocks and non-energy use of fuels in accordance with the UNFCCC reporting guidelines?	No	See para. 33 below

Abbreviations: CRF = common reporting format, NIR = national inventory report, UNFCCC reporting guidelines = "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories".

Comparison of the reference approach with the sectoral approach and international statistics

28. Liechtenstein corrected the inconsistency of the data reported on the difference in energy consumption between the reference and the sectoral approaches in the NIR (0.09 per cent for the 2013 submission) and the CRF tables (0.00002 per cent), addressing the recommendation made in the previous review report. The ERT commends the Party for this correction.

29. No comparison with international data is possible for Liechtenstein as the country is not a member of all relevant international organizations. However, Liechtenstein's data have strong links with Switzerland's. As a result of the Customs Union Treaty between the two States, the import statistics of Switzerland's overall energy statistics[6] also include the fossil fuel consumption of Liechtenstein (except for gas consumption). Liechtenstein's Office of Environment calculates the country's energy consumption and provides data to the Swiss Federal Office of the Environment (FOEN), which then can correct Swiss fuel consumption data by subtracting Liechtenstein's liquid fuel consumption. Overall, liquid fuel consumption is therefore consistent with Swiss national statistics before correction.

30. The previous review report raised a problem of inconsistency regarding biofuels between the NIR, which reports that biofuel was produced in Liechtenstein until 2009, and CRF table 1.A(b), where the production of liquid biomass has the notation key "NO". The 2014 NIR (page 97) clarifies that there was never any biofuel production in Liechtenstein but there were imports, and that the notation key in CRF table 1.A(b) is correct. The ERT commends the Party for this improvement.

[6] Schweizerische Gesamtenergiestatistik 2010. *Statistique globale Suisse de l'énergie 2010*. Bern: Swiss Federal Office of Energy. Available at <http://www.bfe.admin.ch/themen/00526/00541/00542/00631/index.html?lang=de&dossier_id=00763>.

International bunker fuels

31. As a landlocked country, there are no international maritime bunkers in Liechtenstein. Emissions from international aviation occur only from two companies that operate helicopters in Liechtenstein. The NIR (chapter 3.2.2, International bunker fuels and chapter 3.2.6.8.a, Aviation) explains the procedures used to split emissions from aviation into domestic and international for 1990–2011, based on the results of studies from 1995, 2001 and 2002, and the assumptions to extrapolate these data. For 2012, actual disaggregated AD for international and domestic aviation are available from the two companies. The ERT recommends that, in order to report consistent and comparable time series, the Party determine the share between domestic and international aviation for the years of the 2003–2011 period based on data collected in 2002 and 2012 in a similar manner to Liechtenstein's approach for the period 1996–2000 (i.e. data interpolated based on available data for 1995 and 2001).

32. The ERT noted some discrepancies in the share of emissions from international aviation between CRF table 1.C and the NIR: CRF table 1.C shows that the share from international aviation is 86.2 per cent for 2001, but the NIR indicates a share of 84 per cent; for 2002, CRF table 1.C reports 84.3 per cent but the NIR reports 86 per cent. In response to a question raised by the ERT during the review, Liechtenstein explained that the statement in the NIR concerning the shares in the years 2001 and 2002 (chapter 3.2.2, page 85) is incorrect, and that the correct values for the shares in 2001 and 2002 are those reported in CRF table 1.C. The ERT recommends that the Party correct the values reported in the NIR and improve its QC procedure to minimize discrepancies between the CRF tables and the NIR.

Feedstocks and non-energy use of fuels

33. Liechtenstein imports lubricants and bitumen (NIR, page 86), but it has continued to report these fuels as "NO" in CRF tables 1.A(b) and 1.A(d) (this issue was also identified in the previous review report). The inventory development plan (NIR, page 300) does not show any improvement in this regard. In addition, for lubricants used for two-stroke engines, the NIR (page 86) indicates that "Lubricants use for 2-stroke engines are considered in the global gasoline sales reported in the national energy statistics". In response to a question raised by the ERT during the review, Liechtenstein explained that it has conducted research to analyse the two most relevant uses of lubricants (in fuel used for two-stroke engines) and bitumen (for asphalt paving) in Liechtenstein. These investigations revealed that there is detailed information about the lubricants used for two-stroke engines available from questionnaires distributed to service stations in the country. The Party stated that it will use this information for lubricants use in the 2015 inventory submission. For bitumen, there are investigations in progress regarding the use of bitumen in asphalt roofing or road paving with asphalt. The ERT commends the Party for this research and reiterates the recommendation made in the previous review report that Liechtenstein report lubricants and bitumen use in CRF tables 1.A(b) and 1.A(d) for the entire time series, including the use of lubricants used for two-stroke engines.

3. Key categories

Stationary combustion: liquid and gaseous fuels – CO_2, CH_4 and N_2O[7]

34. In response to a recommendation made in the previous review report, Liechtenstein reported (NIR, chapter 3.2.6.6, Methodological issues, energy industries, page 92) the

[7] CH_4 and N_2O emissions from this category are not key. However, since all issues related to this category are discussed as a whole, the individual gases are not assessed in separate sections.

evolution of natural gas use in the national territory (22 times higher in 2012 than in 1990), including the significant expansion of the natural gas network and increasing connections within Liechtenstein in the years 1990–1992.

35. In response to a question raised by the ERT during the review, Liechtenstein provided additional information: a table and a graph from the energy statistics 2001 showing the distribution of the fuels used in electricity production and the fact that natural gas consumption for this purpose started only shortly before 1990 (the first unit in the municipality of Triesen functioning with natural gas was installed with a small production of 123 MWh); a table showing the quantity of electricity produced in Liechtenstein indicating that between 1960 and 1977, hydropower was the only electricity produced; and a table showing the sources for electricity production, emphasizing that since about 1990, power generation from natural gas was added to hydropower, and electricity from biogas and photovoltaics was added in 1991 and 1993, respectively. The ERT reiterates the recommendation made in the 2012 review report that the Party incorporate all the information provided during the review in the NIR, to improve the transparency of the description of the sources for electricity production and the trend of natural gas use in Liechtenstein.

36. For the subcategory manufacturing industries and construction, the ERT acknowledges that the NIR has been updated with transparent information on the applied methodology concerning the AD and EFs and their trends, addressing a recommendation made in the previous review report. The ERT commends the Party for the transparency improvements to its NIR.

37. The ERT noted a recommendation made in the previous review report that Liechtenstein reallocate the data on fuel consumption and emissions from construction and industrial off-road machinery from the category other (fuel combustion) to the category other (manufacturing industries and construction). The Party has addressed this recommendation in the CRF tables, reporting the consumption of diesel oil in off-road vehicles and other machinery in other (manufacturing industries and construction). The ERT commends the Party for this action. However, the Party has not corrected the description of the allocation in the NIR (see NIR, chapter 3.2.6.9, page 104 and chapter 10, page 217). The ERT recommends that Liechtenstein update the description in the NIR.

38. The ERT noted that NIR table 3-15 (page 89) indicates that military aviation does not occur and that if it did occur, its emissions would be reported under other transportation; however, the ERT notes that if military emissions occur in the future they should be reported in the subcategories stationary and mobile under other (fuel combustion), and not under other transportation. The ERT further noted that NIR table 3-28 (page 106) reports CO_2 emissions from military aviation as "0.00" in the category other transportation rather than in the subcategory mobile under other (fuel combustion). In response to a question raised by the ERT during the review, Liechtenstein explained that there are no military activities (aviation or other) in the country. The ERT recommends that Liechtenstein report these emissions as "NO" and explain that there are no military activities in the country.

39. The ERT noted that headings are included in the NIR (section 3.2.6.5, page 90 and section 3.2.6.9.c, page 104) and CRF tables (1.A(a)s4) that seem to indicate that emissions from off-road vehicles in construction and industry are reported in the subcategory mobile under other (fuel combustion), but that the text under those headings and NIR table 3-14 (page 89) indicate that these emissions are reported under other (manufacturing industries and construction). In response to a question raised by the ERT during the review, Liechtenstein explained that in the 2014 submission AD and emissions from off-road vehicles in construction and industry have been correctly reported under other (manufacturing industries and construction), following the recommendation made in the

previous review report. The Party acknowledged that these section headings in the NIR may be misleading. The ERT recommends that the Party improve the transparency of the NIR and consistency with the CRF tables.

40. The NIR (pages 88–89) indicates that there are two sites under the European Union Emissions Trading System[8] (EU ETS) included in the estimates for manufacturing industries and construction. The ERT noted that these two sites represented 60 per cent of total CO_2 emissions from the manufacturing industries and construction category in 2008 but only 8 per cent in 2011 (NIR pages 31, 89 and 295). The ERT commends Liechtenstein for explaining in its NIR (page 94) that this large decrease results from replacing steam generation generated in the plants with steam imported from Switzerland.

41. The NIR (page 88 and table 3-14, page 89) indicates that all emissions from liquid and gaseous fuels from the category food processing, beverages and tobacco are reported under the category other (manufacturing industries and construction). The ERT notes that this is not in line with the *Revised 1996 IPPC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPPC Guidelines), as had been discussed in previous review reports. The NIR (page 88) indicates that the data needed for disaggregation are not available. However, the previous ERT noted that the two companies reporting under the EU ETS and listed in the NIR are part of the food industry. The current ERT also noted that the NIR (page 89) indicates that the emissions of these two companies are confidential. The ERT noted that emissions of these two companies for 2008–2012 are available (but not publicly) as required by the EU ETS. The ERT also noted that emissions data from 2013 onwards are publicly available.[9] The ERT recommends that Liechtenstein review the confidentiality of the emissions estimates and AD with the two operators in order to report this information in the category food processing, beverages and tobacco for 2008–2012. In response to a question raised by the ERT during the review, the Party recognized the availability of the above-mentioned data and stated that the effort for adapting the data for 2008 to 2012 is high in comparison with the small share (less than 10 per cent) of these emissions in the total emissions from the category other (manufacturing industries and construction). The Party indicated that for the next submission all data will be updated and reallocated to the correct categories (food processing, beverages and tobacco or other (manufacturing industries and construction)), for the year 2013 onwards. The ERT welcomes the intention of the Party to act in this matter and recommends that the Party implement this reallocation for the applicable years in the entire time series 1990–2012. Also, the ERT reiterates the encouragement made in the previous review report for the Party to use the industry reports available from the EU ETS as part of its QA/QC plan to cross-check the emissions and AD of the category.

Road transportation: liquid fuels – CO_2

42. In response to a recommendation made in the previous review report, Liechtenstein improved the transparency of its NIR by stating that the consumption of lubricants used as an additive to gasoline consumed in two-stroke engines is included in the global gasoline sales reported in the national energy statistics (chapter 3.2.3, Feedstocks and non-energy use of fuels, page 86). The ERT commends the Party for the improved transparency in the current review report and recommends that the Party report lubricants use separately from fuel consumption in this category in the next submission (see para. 33 above).

[8] Commission decision 2007/589/EC establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to directive 2003/87/EC of the European Parliament and of the Council.

[9] Available on the website of the European Environment Information and Observation Network: <http://cdr.eionet.europa.eu/li>.

43. The NIR (page 97) states that biofuels are not produced in Liechtenstein. Biofuels were imported and then mixed with other road transport fuels from 2007 to 2009; after 2009, the only distributor that imported biofuels closed. Liechtenstein assumes that all gasoline and diesel oil fuels imported from Switzerland do not contain biofuel. Biofuel consumption is therefore reported only for 2007 to 2009. In response to a recommendation made in the previous review report that Liechtenstein check whether biofuel is not already mixed in the imported gasoline and diesel oil fuels and document this, the Party explained in the NIR (chapter 3.2.6.8.b, Road transportation, page 99) that no biofuel production exists in Liechtenstein and no biofuel is mixed in the imported gasoline and diesel fuels. The ERT commends the Party for the provided clarification.

44. The NIR (chapter 3.2.6.8.b, Methodological issues – Transport, road transportation (1A3b), page 97) states that CO_2 emissions from biofuels used in road transportation (occurring only for 2007–2009) are "not reported under 1A3b [road transportation] but under Memo items 'biomass'". The same information is provided in the NIR table 3-2 (page 74). However, the ERT noted that Liechtenstein has reported CO_2 emissions (and also CH_4 and N_2O emissions) from biomass (liquid fuels) under road transportation for 2007–2009. The ERT recommends that Liechtenstein revise the information in the NIR to clarify the explanation and make it consistent with the information reported in the CRF tables.

Other sectors: liquid fuels – CO_2

45. For gasoline, a survey on all selling stations and consumers established in 2011 that the gasoline is consumed mostly in forestry (80 per cent), and the Party has allocated the remaining 20 per cent to residential. This share was extrapolated to the entire time series. The ERT commends the Party for the transparent information included in the NIR.

4. Non-key categories

Navigation: other liquid fuels – CO_2, CH_4 and N_2O

46. The NIR states that navigation is not occurring in Liechtenstein because there are no lakes, and the Rhine River is not navigable in the territory of Liechtenstein. Therefore, no emissions are occurring for other liquid fuel in this category. In response to a recommendation made in the previous review report, the Party has reported AD and emissions as "NO" in the CRF tables. The ERT commends the Party for this improvement.

Other transportation: liquid fuels – CO_2, CH_4 and N_2O

47. The ERT noted that AD and emissions from other transportation are reported as "NO" in CRF table 1.A(a)s3. In response to a question raised by the ERT during the review, Liechtenstein stated that neither fuel consumption by the equipment supporting the pipeline transportation activities of natural gas, nor ground activities in airports are occurring in Liechtenstein. The ERT recommends that the Party include this information in the NIR to improve the transparency of the NIR.

Oil and natural gas – CH_4

48. Following a recommendation made in the 2012 review report, fugitive CH_4 emissions from natural gas were split: emissions from transmission are reported separately from emissions from distribution (which include CH_4 emissions from distribution and other leakage) in the 2013 and 2014 annual submissions. However, the NIR does not include all the AD and parameters used in the estimation of these emissions.

49. In response to a question raised by the ERT during the review, Liechtenstein explained completely the estimations of the fugitive emissions for natural gas transmission, distribution and other leakage categories, including the values of the parameters used for

natural gas (density and the net calorific value based on volume, the temperature and pressure conditions for which the natural gas parameters are determined).

50. When reconstructing the emission estimates with the information in the NIR and information provided during the review, the ERT noted that, in addition to the losses in the transmission and distribution network and those relating to the connections of gas meters, the Party estimates the fugitive CH_4 emissions resulting from: maintenance activities of the natural gas network; the distribution network components; losses at the services end-user; and losses at the industry end-user. The method is consistent with the tier 3 approach, adapted from the NIR of Switzerland, and the characteristics of the fuel are based on the 2013 natural gas quality data from FOEN. The ERT recommends that the Party explain in detail the methodology used, and provide and reference in the NIR all the AD and parameters used. The ERT also recommends that the Party report CH_4 emissions from natural gas distribution activities separately from the CH_4 emissions from other leakage of natural gas activities (losses at the services end-user).

C. Industrial processes and solvent and other product use

1. Sector overview

51. In 2012, emissions from the industrial processes sector amounted to 8.38 Gg CO_2 eq, or 3.7 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 0.91 Gg CO_2 eq, or 0.4 per cent of total GHG emissions. Since the base year, emissions have increased by 8,825,057.8 per cent in the industrial processes sector, and decreased by 54.5 per cent in the solvent and other product use sector. Within the industrial processes sector, all the emissions were from consumption of halocarbons and SF_6 (all other subsectors were reported as "NA" or "NO"). The key drivers for the rise in emissions in the industrial processes sector are increased use of refrigeration and air-conditioning equipment.

52. Liechtenstein has made one recalculation between the 2013 and 2014 annual submissions for the industrial processes sector. The recalculation was in consumption of halocarbons and SF_6. The recalculation was made following changes in AD. Compared with the 2013 annual submission, the recalculation decreased emissions in the industrial processes sector for 2011 by 0.77 Gg CO_2 eq (8.7 per cent), and decreased total national emissions by 0.3 per cent. The recalculations were adequately explained.

2. Key categories

Consumption of halocarbons and SF_6 – HFCs, PFCs and SF_6[10]

53. The NIR (page 115) indicates that emissions from refrigeration and air-conditioning equipment are mostly calculated by applying a rule of proportion to the relevant emissions from Switzerland. The NIR states that this is done because the AD for country-specific calculations are not available in Liechtenstein and because consumption patterns for industry, service sector and household sector of Liechtenstein and Switzerland are very similar. HFC emissions are calculated by first relating the relevant emissions from Switzerland to an appropriate driver (e.g. the number of households for domestic refrigeration, the number of passenger cars for mobile air conditioning). The resulting category-specific EFs (e.g. emissions from domestic refrigeration per household) are then multiplied with the respective driver value for Lichtenstein (e.g. number of households).

[10] PFCs and SF_6 emissions from this category are not key. However, since all issues related to this category are discussed as a whole, the individual gases are not assessed in separate sections.

The ERT considers that this is in line with the tier 2 approach under the Revised 1996 IPCC Guidelines, as long as the sources of emissions in a category are the same in both countries. However, this is not the case for the manufacture and disposal of refrigeration and air-conditioning equipment, which does not occur in Liechtenstein according to the NIR (page 115) and therefore the ERT considers that Liechtenstein may be overestimating its HFC emissions from this category. The NIR states that accuracy could be improved by excluding emissions from manufacture, but that this bias is kept because emissions are low. The NIR indicates that emissions from disposal remain included to consider the theoretical possibility of unofficial disposal. In order to reduce overestimation of emissions and avoid double counting of emissions between Liechtenstein and Switzerland, the ERT recommends that Liechtenstein exclude the emissions from manufacture from the estimates. The ERT also recommends that the Party assess how the accuracy of the estimation of emissions from disposal can be improved to avoid overestimating these emissions.

54. As HFC emissions under the category refrigeration and air-conditioning equipment are calculated based on the relevant emissions from Switzerland (see para. 53 above), Liechtenstein is dependent on these estimations being made in time to allow Liechtenstein to comply with the deadline for submission of its inventory. While the Swiss estimates were available in time for the 2014 submission, this was not always the case in earlier years (NIR, page 112). The ERT encourages Liechtenstein to explore the possibilities for an agreement with Switzerland ensuring provision of the Swiss estimates to allow a timely submission by Liechtenstein.

55. In its 2014 submission (NIR, page 116), Liechtenstein states that there is a stagnating trend for HFC emissions for the period 2004–2006 in Liechtenstein, while this is not the case in Switzerland, and that this deviation arose from the methodological approach used. In response to a question raised by the ERT during the review, Liechtenstein explained that this statement stemmed from comparing the development of HFC-134a emissions from mobile air conditioning in Liechtenstein with total HFC emissions in Switzerland. Trends of total HFC emissions in Liechtenstein and Switzerland both continuously increased in the period 2004–2006. The stagnation of HFC-134a emissions in Liechtenstein can be explained by the stagnation in total passenger cars, which is used as AD for the emission estimation. Liechtenstein has indicated that the statement in the NIR will be corrected in the 2015 submission. The ERT recommends that the Party make the correction as indicated.

56. In CRF table 2(II)s2 the ratio of potential/actual emissions is included for total HFCs as well as for total PFCs and SF_6 (e.g. for 2012 the ratios are 15.50, 10.54 and 23,550.00 for HFCs, PFCs and SF_6, respectively). However, the related potential emissions are not included for HFCs and PFCs, and neither are the potential emissions for the individual HFCs and PFCs for which emissions occur. In response to a question raised by the ERT during the review, Liechtenstein clarified that potential emissions had been calculated for HFCs (aggregated), PFCs (aggregated) and SF_6, but had not been transferred from the CRF software (the CRF Reporter) to the CRF tables. The Party also explained that it had discussed the problem with the CRF Reporter help desk, but no solution could be found. The Party further explained that, as potential emissions will not be included from the 2015 submission onwards, the problem will not persist in the future.

D. Agriculture

1. Sector overview

57. In 2012, emissions from the agriculture sector amounted to 23.26 Gg CO_2 eq, or 10.3 per cent of total GHG emissions. Since 1990, emissions have decreased by 0.4 per cent. The key drivers influencing the emission trend are the increase in cattle population

since 2000 and inter-annual changes in crop yields.[11] Within the sector, 47.0 per cent of the emissions were from enteric fermentation, followed by 37.9 per cent from agricultural soils and 15.1 per cent from manure management. Rice cultivation and field burning of agricultural residues are reported as "NO". Prescribed burning of savannas and emissions from other (agriculture) were reported as "NA".

58. Liechtenstein has made recalculations between the 2013 and 2014 annual submissions for the agricultural soils category. The recalculation was performed to bring the area of cultivated organic soils in line with similar data for the LULUCF sector. As a result of the recalculation, emissions decreased by 1.1 per cent for 2011. The recalculation was made in response to recommendations made in the 2013 annual review report. Compared with the 2013 annual submission, the recalculation decreased emissions in the agriculture sector for 2011 by 0.10 Gg CO_2 eq, and decreased total national emissions by 0.05 per cent. The recalculation was adequately explained. The ERT welcomes the efforts made by the Party to improve the accuracy of its estimates.

59. In addition, in response to the list of potential problems and further questions raised by the ERT during the review, Liechtenstein recalculated CH_4 emissions from manure management and, as a consequence, N_2O emissions from manure management and from agricultural soils for the entire time series 1990–2012 based on updated animal waste management system (AWMS) shares (see para. 67 below). Compared with the submission made on 15 April 2014, the estimates for 2012 submitted on 3 November 2014 increased CH_4 emissions from manure management by 3.7 per cent and decreased N_2O emissions from manure management and from agricultural soils by 2.1 per cent and 2.2 per cent, respectively. The aggregated effect of this update to the AWMS shares is that total emissions from the agriculture sector for 2012 decreased by 0.7 per cent, from 23.42 Gg CO_2 eq to 23.26 Gg CO_2 eq.

60. The inventory data, methodology and assumptions of Liechtenstein generally follow the Swiss GHG inventory because of similarities of soil, climatic and agricultural conditions between Liechtenstein and Switzerland. The ERT considers that such an approach is appropriate in this specific case.

61. Liechtenstein has improved its inventory for the agriculture sector since the previous annual submission by addressing some of the recommendations made in the previous review report. However, the ERT considers that the NIR is not completely transparent. In particular, background information about the main drivers influencing the trend of cows' milk productivity, cattle population, crop yields and GHG emissions in the sector is not provided in the NIR (e.g. a significant decrease of the cattle population in 2000 illustrated in figure 6-5 in the NIR is not explained). Furthermore, data about country-specific CH_4 EFs as well as values of volatile solids (VS) excreted per animal subcategory for the categories enteric fermentation and manure management are not provided in the NIR. The ERT recommends that the Party include all relevant information.

62. The ERT noted that the checklist for QC activities (NIR, annex 8) does not include a comparison of country-specific EFs, VS, nitrogen excretion (Nex) rates and fractions of nitrogen (N) lost from fertilizers with the corresponding default values in the Revised 1996 IPCC Guidelines or in the IPCC good practice guidance from countries with similar conditions, as prescribed in the IPCC good practice guidance. Data for crop production and application of fertilizers are not cross-checked with similar values used in the LULUCF

[11] Crop yields are used to estimate emissions from the subcategories nitrogen-fixing and crop residue. Together, these two subcategories represent 41 per cent of total direct soil emissions for 2012. Therefore, the inter-annual changes in crop productivity and yields result in higher or lower N_2O emissions.

sector. In response to a question raised by the ERT during the review regarding these gaps in the QC procedures, Liechtenstein explained that all these parameters have been analysed and compared with other countries within a verification study. The analysis showed that the data for Switzerland and Liechtenstein are within the range of Western European countries. The ERT noted that such an analysis has been carried out only once to date, in 2011. The ERT recommends that the Party include the comparison analysis of national and other data sources in its QC checklist and report on the results on an annual basis.

63. As indicated in chapter 6.3.2 of the NIR, livestock head numbers are used to calculate CH_4 emissions while animal "place" numbers are used to calculate N_2O emissions. The ERT noted that the discrepancy between the division of livestock per head and per place is not transparently described in the NIR. In response to a question raised by the ERT during the review, Liechtenstein provided the ERT with a publication[12] that describes the approaches used for population data collection, treatment and use for the Swiss GHG inventory. The document defines "animal place" and justifies its use for Nex calculation. In particular, it is stated that Nex calculated based on livestock places accounts for the population of growing animals that are alive for only a part of a complete year. In addition, animal place may combine several livestock subcategories (e.g. Nex of goat places includes all N excreted by a female goat, all corresponding young and replacement animals as well as the N excreted by the corresponding share of male goats). Animal place numbers are used only for the purpose of Nex estimation. The ERT is of the view that the approach used to derive Nex values by Switzerland and also used in Liechtenstein's inventory is more accurate and appropriate for Liechtenstein than the default IPCC methodology (equation 4.19 of the IPCC good practice guidance). To increase transparency, the ERT recommends that the Party include detailed explanatory information on animal place and the estimation of Nex in its NIR.

2. Key categories

Enteric fermentation – CH_4

64. Liechtenstein has estimated emissions from enteric fermentation of all the livestock species using a tier 2 methodology (equation 4.14 of the IPCC good practice guidance). In addition, the Party has also estimated CH_4 emissions from enteric fermentation for poultry, although there is no default methodology for this livestock. The ERT commends the Party for reporting beyond the mandatory requirements. Cattle is the dominant source of emissions from enteric fermentation. Gross energy (GE) values for cattle are derived using a country-specific approach that is based on the conversion factors of net energy (or metabolizable energy in the case of milk-fed calves) to GE. According to the NIR (chapter 6.2.2.1) average data for weight, growth rate, feed intake, feed energy intake and energy required for milk production were utilized for the estimation of GE. However, these data per cattle subcategory are not included in the NIR. In response to a question raised by the ERT during the review, the Party presented to the ERT all the data required in tabular format and explained that they are the same as for Switzerland. The ERT recommends that the Party include this table with the parameters used to estimate GE for cattle in the NIR.

65. The ERT noted that most of the parameters in the additional information table to CRF table 4.A (except some parameters for "mature dairy cattle" and "mature non-dairy cattle") are reported as "NA" or "NE" (not estimated) despite the fact that the Party has used these parameters to calculate emissions from livestock. The ERT recommends that the Party replace notation keys with numerical data in the additional information table where it

[12] Bretscher D and Kupper T. 2012. *Categorization of Livestock Animals in Switzerland.* Reckenholz-Tänikon Research Station ART, Zurich: Agroscope.

is appropriate or justify the use of notation keys in footnotes or documentation boxes to CRF table 4.A.

66. According to the NIR (chapter 6.2.2.2), the methane conversion rate used to estimate emissions from cattle enteric fermentation is 6 per cent, the default value from the IPCC good practice guidance (table 4.8, data for developed countries). The ERT noted that, in CRF table 4.A, the reported methane conversion rate for mature dairy and non-dairy cattle is 6.0 per cent but for young cattle the reported rate is 5.95 per cent. In response to a question raised by the ERT during the review, Liechtenstein explained that the value for young cattle is a weighted average between all production stages of young cattle (fattening calves, pre-weaned calves, breeding cattle first, second and third years as well as fattening cattle). The Party further explained that the methane conversion rate for calves is assumed to be 0.0 (zero) per cent at the beginning of their lives (0–98 days). This leads to a lower weighted average methane conversion rate for young cattle compared with mature cattle. The ERT recommends that Liechtenstein include this information in its NIR and in the documentation box to CRF table 4.A.

Manure management – CH_4 and N_2O

67. Liechtenstein has estimated CH_4 emissions from manure management of cattle and swine using the same methodology and most of the background data and assumptions as Switzerland (NIR, chapter 6.3.2). Data on manure allocation per AWMS used by the Party are constant for the period 1990–2012 and are based on the Swiss survey undertaken in 2002. Switzerland, in its 2013 inventory, updated its manure allocation per AWMS for cattle and swine using data from surveys made in 2007 and 2010. With this new data, CH_4 emissions from manure management of cattle and swine for 2010 in the Swiss inventory increased by about 0.5 and 0.9 per cent, respectively, owing to a slight increase in the share of liquid systems, which have the highest methane conversion factor (MCF) value among the AWMS used in Switzerland (10 per cent). However, Liechtenstein has not updated its manure allocation per AWMS to consider data from the 2007 and 2010 Swiss surveys. The ERT considered that, because the Party has not updated the manure allocation per AWMS, the CH_4 emissions from manure management of cattle and swine are potentially underestimated. The ERT included this issue in the list of potential problems and further questions raised by the ERT during the review.

68. In response to the list of potential problems and further questions raised by the ERT during the review, Liechtenstein submitted revised estimates for the whole time series using the latest data used in the Swiss inventory. As a result, CH_4 emissions from manure management for 2012 increased by 4.4 per cent for cattle and by 0.2 for swine. The ERT considers that the issue has been resolved. The ERT noted that by using the latest data from the Swiss inventory, Liechtenstein also updated the ammonia EFs and the Nex values in order to be fully consistent with Switzerland's AGRAMMON model and, as a result, also updated the estimation of N_2O emissions from manure management and agricultural soils (see para. 59 above). The ERT recommends that the Party explain these methodological changes in its NIR. The ERT further recommends that Liechtenstein investigate the possibility of gathering country-specific AWMS data, because this parameter is used within all key categories in the agriculture sector. The lack of reliable AWMS data can be addressed for example by extrapolating AWMS trends from a sample area or region to the entire country, if climatic conditions and agricultural practices are similar.

69. Liechtenstein has reported the typical animal mass of mature dairy and mature non-dairy cattle as "NE" in CRF table 4.B(a) but the Party has reported values in CRF table 4.A. The ERT recommends that the Party replace the notation key "NE" in CRF table 4.B(a) with the values reported in CRF table 4.A. The ERT also recommends that the Party improve its QC procedures to ensure the consistency of the information provided in the CRF tables.

70. Liechtenstein has reported fractions of manure per AWMS that do not occur (such as anaerobic lagoons, daily spread, dry lot and other) as "0" (zero) in CRF table 4.B(a). The ERT recommends that the Party report these cases as "NO" rather than zero in CRF table 4.B(a).

Direct soil emissions – N_2O

71. The ERT noted that N_2O emissions from N-fixing crops for 2011 are the highest in the time series and 12.4 per cent and 12.8 per cent higher than in 2010 and 2012, respectively. In response to a question raised by the ERT during the review, Liechtenstein explained that the key driver for these emissions is the increase in the areas of leguminous crop, meadows and pastures just for that year. The ERT recommends that the Party include in the NIR information about factors that influenced the sharp increase of emissions from N-fixing crops in 2011.

72. The ERT noted that reference to the legislation that prohibited the use of sewage sludge as fertilizer (reported, together with compost as fertilizer, in the category other direct emissions) since 2004 is not provided in the NIR. In response to a question raised by the ERT during the review, the Party provided the ERT with the regulation (in German). The ERT recommends that the Party refer to this document in its NIR.

3. Non-key categories

Field burning of agricultural residues – CH_4 and N_2O

73. Liechtenstein has reported crop production for all crops as "NA" in CRF table 4.F. Residue/crop ratio, dry matter fraction, fraction oxidized, carbon fraction of residue and nitrogen/carbon ratios in biomass residues are reported as "NE". Fraction burned in fields, total biomass burned, EFs and emissions are reported as "NO". As field burning of agricultural residues does not occur in Liechtenstein, the ERT recommends that the Party report AD and emissions as "NO" and the implied emission factor (IEF) as "NA" in CRF table 4.F.

E. Land use, land-use change and forestry

1. Sector overview

74. In 2012, net removals from the LULUCF sector amounted to 6.91 Gg CO_2 eq. Since 1990, net removals have decreased by 27.0 per cent. The key driver for the fall in removals is an increase in emissions from land converted to grassland and land converted to other land. Within the sector, 19.94 Gg CO_2 eq of net removals were from forest land. Net emissions were reported from cropland (4.61 Gg CO_2 eq), settlements (3.77 Gg CO_2 eq), grassland (3.24 Gg CO_2 eq), other land (1.19 Gg CO_2 eq) and wetlands (0.22 Gg CO_2 eq).

75. Liechtenstein has not made recalculations between the 2013 and 2014 annual submissions for this sector.

76. In Liechtenstein, land-use statistics (based on aerial photographs) are available for the years 1984, 1996, 2002 and 2008. In response to a question raised by the ERT during the review, Liechtenstein reported that the hectare-based approach of Switzerland, which was used for the GHG inventory, was of limited use for other non-inventory purposes and was very expensive. Therefore, a survey was not conducted in 2012 and Liechtenstein assumed, based on expert judgement, that land-use changes were small. To fill data gaps, Liechtenstein applied linear interpolation and extrapolation, which involve assumptions with regard to trends for the periods concerned to estimate emissions and removals in the LULUCF sector for 1990–2012. In response to a request by the ERT that the Party justify the extrapolations (for 2009–2012), Liechtenstein reported that work is under way to

compile statistics in 2015 and that, because of a lack of data, it is not yet possible to estimate how good the extrapolation fits actual data. The ERT encourages Liechtenstein to continue to develop its land area identification system in order to obtain accurate data, or validate data calculated by extrapolation.

77. For key categories in the LULUCF sector, uncertainty estimates are provided, but no methodology is reported in some cases (e.g. the uncertainty of the AD values in the various land-use categories). In response to a question raised by the ERT during the review, the Party explained that the method to derive uncertainties was the following: EF uncertainties for the LULUCF sector were taken from the Swiss GHG inventory, submission April 2013 (April 2014 contains more elaborated uncertainties but, because of the schedule, they could not be adopted for Liechtenstein in time for the 2014 submission and will be adopted for the 2015 submission), whereas AD uncertainties for the LULUCF sector were provided by the Office of Environment. The ERT recommends that Liechtenstein improve the descriptions of the methodology for estimating uncertainties and the reporting of the uncertainty values its NIR in order to increase transparency.

2. Key categories

Forest land remaining forest land – CO_2

78. For gross biomass growth, as well as harvest and mortality rates, Liechtenstein applied constant rates throughout the estimation period, which were calculated based on the Swiss national forest inventory (NFI) data from 1985 (NFI I) and 1995 (NFI II; NIR table 7-13). The ERT considers that because the rates of natural processes in forests (i.e. growth and mortality) depend on both environmental factors and the constantly changing structure of the forest by age and species, and because the harvest rates depend on changing economic factors, all these rates can change rather significantly over time. In response to a question raised by the ERT during the review, Liechtenstein reported that it plans to check and improve these data in the next submission. The ERT recommends that Liechtenstein apply the data from the most recent Swiss NFI after checking that these data are applicable to the circumstances in Liechtenstein, or collect additional (country-specific) data.

79. Similar to biomass growth and harvest and mortality rates (see para. 78 above), Liechtenstein applied deadwood volume data in forest land from the Swiss NFI II, and assumed that these data are constant for the entire period 1990–2012. This would imply no carbon stock changes in the deadwood pool, yet Liechtenstein reports a very small increase in the carbon stock of the deadwood pool. The ERT recommends that Liechtenstein apply data from the most recent Swiss NFI, which may be more relevant for the most recent periods in the estimation of accurate data, or collect additional country-specific data, and report on the methodology used for estimating carbon stock changes in the deadwood pool.

80. To estimate carbon stocks in forest biomass, Liechtenstein used wood density values as reported in the NIR (page 181). However, the NIR is not specific as to whether the reported values are basic density values (i.e. mass of dry biomass per volume of wood). In response to a question raised by the ERT during the review, the Party confirmed that, indeed, the reported wood density values are basic density values with a unit of tonnes of dry biomass/m^3 wood. The ERT recommends that the Party provide this explanation in its NIR.

Land converted to forest land – CO_2

81. According to the NIR (page 188): "Cut and mortality was inferred from the Swiss land-use statistics NFI I and NFI II, applying the stock change approach on forest areas remaining forest. Thus, the total harvesting amount was already considered. To avoid double counting of the harvesting amount on areas changing from non-forested to forested areas, no additional loss in terms of cut and mortality was accounted for, but the converted

areas were only multiplied with the average annual gross growth of the respective spatial stratum." The ERT considers that it is not clear from the NIR how harvests and mortality were numerically taken into account in the stock values of 90 m^3/ha, 60 m^3/ha and 30 m^3/ha at the age of 20 years that are applied for land converted to forest land. If these are actual stocks then they are the net effects of gross growth, harvests and mortality, which means that harvests on this land, if any, are double counted. In response to a question raised by the ERT during the review, Liechtenstein explained that the growing stock values of 90 m^3/ha, 60 m^3/ha and 30 m^3/ha result from the exponential growth function without harvest and mortality, and that it is very unlikely that the afforested areas (or, according to the land identification system of Liechtenstein, "combination category" (CC)11; NIR, page 175) are harvested before 20 years, as the small trees were planted in order to establish a mature forest (production forest or protective forest) in the long term. The ERT considers that this information adequately clarifies the issue and recommends that Liechtenstein include it in its NIR to improve the description of its estimation methodology for land converted to forest land.

82. Concerning mineral soils in land converted to forest land, Liechtenstein argues that its forest soils are not a net source of emissions. In the calculations, the same mineral soil organic carbon content is assumed for forests and for pre-conversion land where afforestation takes place. However, the ERT considers that the pre-conversion soil organic carbon content may differ not only in terms of the carbon of the litter, fermentation and humus layers, as suggested by Liechtenstein, but also in terms of the mineral layers. Indeed, NIR table 7-8 shows different values for the various non-forest combination categories that may have an effect on how much soil organic carbon may change in afforested land. Also, emissions from carbon stock changes in soils under afforestation may arise from the operations involved in the conversion of land itself (in addition to the processes mentioned on page 187 of the NIR (e.g. management practices, fertilization)). In order to accurately capture these processes (and thereby accurately estimate country-specific stock change factors for land-use conversions), for a tier 2 method and for typical afforestation situations the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) (page 3.92) requires that the plots being compared have similar pre-conversion histories and management as well similar topographic position and soil physical properties, and that they be located in close proximity. Typically, this is achieved using paired-plot comparisons representing converted and unconverted lands so that all factors other than land-use history are the same as possible in the paired plots. The ERT considers that, ideally, several sample locations should be found that represent a given land use at different times since conversion. In response to a question raised by the ERT during the review, Liechtenstein reported that, in its explanation to demonstrate that soils under afforestation are not a net source of emissions, it did not apply this method so as to avoid a possible overestimation of sinks. It is for this reason that Liechtenstein did not use either the carbon content in mineral soils in non-forest categories, which is lower than in forest land, or the carbon content in mineral soils in the forest category. Liechtenstein also explained that, typically, the process of afforestation consists of planting small trees on grasslands; therefore, the conversion itself hardly disturbs the soil structure. The ERT recommends that Liechtenstein improve the description of its methodology to estimate carbon stock changes in mineral and organic soils in land converted to forest land in the NIR in order to increase transparency.

83. The previous review report[13] noted the three categories used by Liechtenstein for land remaining forest land: managed forests; unproductive forests (inaccessible forests and brush forests); and afforestation. Afforestation is defined as an activity that shall be carried

[13] FCCC/ARR/2013/LIE, paragraph 69.

out in an area of land that did not contain forest stocks during the last 50 years, so the previous review report recommended that Liechtenstein report afforestation under the land converted to forest land category rather than in the forest land remaining forest land category. The ERT notes that this issue is relevant and still unresolved. For transparency, the ERT recommends that Liechtenstein report afforestation under the category land converted to forest land rather than in the category forest land remaining forest land, that the Party explain this recalculation in its NIR and that the information in the NIR is moved to the appropriate section (in the 2014 NIR, the text in chapter 7.3.2.1.i would be placed in chapter 7.3.2.2).

3. Non-key categories

Grassland remaining grassland – CO_2

84. Liechtenstein reports carbon stock changes of biomass from vineyards, low-stem orchards and tree nurseries, other orchards, copse and shrub (categories CC32–CC37 according to the land identification system of Liechtenstein) under grassland remaining grassland and not under cropland remaining cropland, although these are typical cropland vegetation types. In response to a question raised by the ERT during the review, the Party explained that these land-use subcategories were adopted from the Swiss NIR in 2008 with the theory that cropland remaining cropland includes only arable land that is actually ploughed on a regular basis. Liechtenstein also explained that this is not the case for CC32–CC37, where typically a permanent grass layer exists. According to Liechtenstein, the soil management of these categories (CC32–CC37) is more similar to the soil management of grassland than to cropland. In areas of shrub vegetation (CC32) there is no perennial crop, only grass and unproductive shrubs. Also vineyards, low-stem orchards and tree nurseries (CC33) and copse (CC34) typically have a permanent grass layer – even in vineyards it is good practice in the country to maintain complete grass cover in order to prevent erosion. However, the ERT noted that this categorization is different from the categorization indicated in the IPCC good practice guidance for LULUCF. The ERT recommends that, in order for the categorization to meet the requirements of the IPCC good practice guidance for LULUCF, Liechtenstein either include, in its NIR, a more detailed justification regarding the above subcategories representing carbon stocks and dynamics of grasslands better than those of croplands, or use the categorization as indicated in the IPCC good practice guidance for LULUCF.

F. Waste

1. Sector overview

85. In 2012, emissions from the waste sector amounted to 2.01 Gg CO_2 eq, or 0.9 per cent of total GHG emissions. Since 1990, emissions have increased by 10.1 per cent. The key driver for the rise in emissions is the increased use of composting in the treatment of solid waste. Solid waste disposal of degradable waste has not taken place in Liechtenstein since 1974, therefore the emissions from this category have significantly decreased since 1990. Within the sector, 52.3 per cent of the emissions were from wastewater handling, followed by 42.6 from composting (reported under the category other (waste)), 3.2 per cent from solid waste disposal on land and 1.9 per cent from waste incineration.

86. Liechtenstein has made recalculations between the 2013 and 2014 annual submissions for this sector. The most significant recalculation was in other (waste), where emissions increased by 13.6 per cent for 2011. The recalculations were made in order to rectify identified errors in AD for wastewater handling and composting. Compared with the 2013 annual submission, the recalculations increased emissions in the waste sector by

0.10 Gg CO_2 eq (5.6 per cent), and increased total national emissions by 0.05 per cent. The recalculations were adequately explained.

87. In addition to the recalculations indicated in paragraph 86 above, Liechtenstein submitted revised estimates for solid waste disposal on land in response to the list of potential problems and further questions raised by the ERT during the review (see paras. 91 and 92 below). For 2012, this change increased CH_4 emissions from solid waste sites from 0.01 Gg CO_2 eq to 0.06 Gg CO_2 eq.

88. In estimating the emissions from the waste sector, Liechtenstein uses methods and assumptions derived from the Swiss inventory submission. The ERT noted that the applicability of the assumptions to national conditions in Liechtenstein is not always known and/or justified. The ERT recommends that Liechtenstein undertake an evaluation to ensure that the methods, parameters and other data provided in its inventory submission are applicable to the national circumstances of Liechtenstein and document these checks in future annual submissions.

89. In section 1.7 of the NIR quantitative estimates for uncertainties for waste categories are given but without any discussion of how the values are derived. The ERT recommends that Liechtenstein provide quantitative uncertainty estimates for all waste categories and discuss the reasons for the estimates in the appropriate section of the waste chapter of the NIR, following the outline for the NIR in the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories".

2. Key categories

90. No key categories have been identified in the waste sector.

3. Non-key categories

Solid waste disposal on land – CH_4

91. Liechtenstein calculated the CH_4 emissions from solid waste disposal in unmanaged sites using a methane generation rate constant (k) value of 0.139/year based on a half-life of five years (NIR, page 204). Liechtenstein used the same k value as Switzerland, stating that the circumstances in Liechtenstein are the same as in Switzerland. In response to a question raised by the ERT during the review regarding the reasoning for the low half-life (or the high k value), Liechtenstein referred the ERT to the Swiss inventory submission as well as to a report referenced in the Swiss NIR, which describes the Swiss calculations in detail. However, the ERT could not find a justification in these reports for the use of the k value, which differs significantly from the default value given in the IPCC good practice guidance (0.05/year), and Liechtenstein could not provide reasons for the selection of this k value.

92. The ERT notes that if waste disposal rates were more or less constant over the time series, the impact of the short half-life (high k value) on the CH_4 emissions from solid waste disposal could be balanced out. However, waste disposal in Liechtenstein has a declining trend, and disposal on land ceased in 1974 (see para. 85 above). Therefore the use of the country-specific k value, with a shorter half-life than the default value from the IPCC good practice guidance, results in a potential underestimation of the CH_4 emissions from this category in the time series 1990–2012. This issue was included in the list of potential problems and further questions raised by the ERT during the review. In response to this list, Liechtenstein submitted revised estimates for the times series 1990–2012 using a k value of 0.09/year (default value for bulk waste for wet conditions in boreal and temperate climate from table 3.3 of the *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, volume 5) and explained why this value better reflects the conditions in Liechtenstein than the default value from the IPCC good practice guidance. The ERT considers that the

revised estimates solved the issue. The ERT recommends that the Party explain these methodological changes in its NIR.

Waste incineration – CO_2, CH_4 and N_2O

93. Liechtenstein's municipal waste is incinerated in Switzerland, so those emissions are included in the Swiss inventory. Liechtenstein reports under this category CO_2, CH_4 and N_2O emissions from illegal open burning of garden, household and construction waste. The emissions are estimated using a methodology based on the core inventory of air emissions (CORINAIR), as adopted in the Swiss inventory. The AD are estimated as 0.5 per cent of the waste generated in Liechtenstein and the EFs are taken from the Swiss inventory. The ERT commends Liechtenstein for its efforts to ensure the completeness of its reporting of the waste sector.

G. Supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

1. Information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

Overview

94. Table 6 provides an overview of the information reported and parameters selected by Liechtenstein under Article 3, paragraphs 3 and 4, of the Kyoto Protocol.

Table 6
Supplementary information reported under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

Issue	*Expert review team assessment, if applicable*	*Findings and recommendations*
Assessment of Liechtenstein's reporting in accordance with the requirements in paragraphs 5–9 of the annex to decision 15/CMP.1	Sufficient	
Activities elected under Article 3, paragraph 4, of the Kyoto Protocol	None	
Period of accounting	Annual accounting	
Liechtenstein's ability to identify areas of land and areas of land-use change in accordance with paragraph 20 of the annex to decision 16/CMP.1	Sufficient	

95. Section G.1 includes the ERT's assessment of the 2014 annual submission against the Article 8 review guidelines and decisions 15/CMP.1 and 16/CMP.1. In accordance with decision 6/CMP.9, Parties will begin reporting of KP-LULUCF activities in the submissions due by 15 April 2015 using revised CRF tables, as contained in the annex to decision 6/CMP.9. Owing to this change in the CRF tables for KP-LULUCF activities, and the change from the first commitment period to the second commitment period, paragraphs 96–98 below contain the ERT's assessment of Liechtenstein's adherence to the current guidelines for reporting and do not provide specific recommendations for reporting of these activities for the 2015 annual submission.

Activities under Article 3, paragraph 3, of the Kyoto Protocol

Afforestation and reforestation – CO_2

96. Liechtenstein does not report areas, emissions and removals from afforestation and reforestation older than 20 years under the activity afforestation and reforestation under Article 3, paragraph 3, of the Kyoto Protocol. The Party has assumed that these areas are to be reported under the activity forest management under Article 3, paragraph 4, of the Kyoto Protocol. However, Liechtenstein has not elected forest management. The ERT considers that areas under the activity afforestation and reforestation reported in KP-LULUCF table NIR-2 can only decrease as a result of deforestation of these areas. The ERT noted that decision 16/CMP.1 (annex, paragraph 19) reads "Once land is accounted for under Article 3, paragraphs 3 and 4, all anthropogenic greenhouse gas emissions by sources from, and removals by sinks on this land must be accounted for throughout subsequent and contiguous commitment periods." The ERT also noted section 4.1.2 of the IPCC good practice guidance for LULUCF (pages 4.15–4.16): "Once a land is reported under Article 3.3 or Article 3.4, all anthropogenic greenhouse gas emissions by sources and removals by sinks on this land must be reported during the first and throughout subsequent and contiguous commitment periods, except the Party chooses not to report a pool that has been shown not to be a source as explained in Section 4.2.3.1. That is, the total land area included in the reporting of Article 3.3 and 3.4 activities can never decrease." The only exception to this rule is when "[a]fforestation/reforestation land that is subsequently deforested is reclassified as deforestation land". The IPCC good practice guidance for LULUCF also states that "afforestation, reforestation and deforestation have precedence over the other activities for land classification and reporting purposes not only in a given year, but for the entire period between 1990 and 2012." Therefore, the ERT notes that all lands that have been afforested since 1990 should be reported under afforestation and reforestation under Article 3, paragraph 3, of the Kyoto Protocol. The ERT further notes that because the Party did not include all areas, net removals reported under afforestation and reforestation for 2008–2012 are probably underestimated.

97. With respect to growing stock at 20 years of age for forests on good, medium and poor sites (NIR table 7-22) reported under afforestation, Liechtenstein applies a number of assumptions. In response to a question raised by the ERT during the review, the Party reported that these assumptions are necessary, as the most recent Swiss NFI (i.e. NFI III), which is the main source of information for the GHG inventory of Liechtenstein for the LULUCF sector and KP-LULUCF activities, does not provide much information on this growing stock. Therefore, the stock difference between the Swiss NFI I and II was used by Switzerland and, subsequently, by Liechtenstein for validating the exponential growth function for young forests. The ERT encourages Liechtenstein to harmonize the carbon values of afforestation (CC11) with the most recent values used in the Swiss NIR, or to explore other possible options by applying country-specific data, in order to increase the accuracy and reduce the uncertainty of the estimates in this key category.

Deforestation – CO_2

98. In the 2014 submission of 15 April 2014, Liechtenstein reports 0.1291 kha, 0.007006 kha, 0.0417 kha and 0.0173 kha of conversion of forest to grassland, wetlands, settlements and other land, respectively, for 2012, under the Convention in CRF tables 5.C, 5.D, 5.E and 5.F. The sum of these areas is 0.1951 kha. However, Liechtenstein reports an area of 0.021046 kha for deforestation under the Kyoto Protocol for 2012 in KP-LULUCF table 5(KP-I)A.2. The ERT notes that the area reported under deforestation under the Kyoto Protocol for 2012 (0.021046 kha) is nine times smaller than the sum of the areas for conversions of forest land indicated above (0.1951 kha).

99. Liechtenstein reports in the NIR (page 228) that, under deforestation, it includes only areas that are considered "direct human induced". However, the ERT considers that the definitions related to deforestation (in particular, "human-induced" and "non-human induced" deforestation) in the NIR and the information received from the Party during the review week do not sufficiently justify the difference between the areas of conversion of forest land to other land categories under the Convention and the areas reported for deforestation under the Kyoto Protocol. In the opinion of the ERT, the difference in areas is not justified because the total area of forest land converted to settlements (a permanent non-forest use) for 2012 as reported under the Convention (CRF table 5.E) is 0.0417 kha, which in itself is almost twice the area reported for deforestation for 2012 under the Kyoto Protocol: 0.021046 kha.

100. According to the IPCC good practice guidance for LULUCF (page 4.57), "[i]f … the natural disturbance is followed by a non-forest land use, then this will prevent the regeneration of forest, and the deforestation must be considered direct human induced." The ERT considers that, based on all the information received by the end of the review week, the reporting for deforestation under the Kyoto Protocol is incomplete because the Party has not included all areas deforested in its estimates reported in the KP-LULUCF tables. As a result, the ERT considers that CO_2 emissions from deforestation under the Kyoto Protocol are potentially underestimated for 2008–2012. The ERT included this issue in the list of potential problems and further questions raised by the ERT during the review.

101. Liechtenstein, in its response to this list, submitted revised estimates. In these estimates, areas, emissions and removals of deforestation reported in KP-LULUCF table 5(KP-I)A.2 were recalculated using values consistent with the values in CRF tables 5.C, 5.D and 5.E, as recommended by the ERT. Liechtenstein noted that the areas converted from forest land to other land (and reported in CRF table 5.F) are not reported under KP-LULUCF activities because: (1) these conversions are most likely not directly human induced; and (2) there is no human activity in the converted areas that would prevent regeneration (in Liechtenstein, other land consists of unmanaged areas without soil (e.g. rocks, sand, scree and glaciers)). Liechtenstein also explained that an analysis of Liechtenstein's land-use data from the AREA surveys of 1996, 2002 and 2008 revealed that 6 per cent of the area deforested between 1996 and 2002 was not permanent as it was forest again in 2008. This means that a reduction of crown coverage visible in the aerial photographs in 2002 led to the use of a non-forest code but natural regeneration led to a forest code again in the 2006 survey; thus, Liechtenstein does not report the areas with these short-term reductions of crown coverage under the KP-LULUCF activities on the grounds that: (1) if the crown cover reduction resulted from natural hazards the land-use change was not directly human induced and the following land use did not prevent regeneration of the forest; and (2) if the crown cover reduction was directly human induced it should be classified as "management interventions" rather than as real land-use change, because the intervention did not lead to a land-use change in the long term.

102. Liechtenstein also noted that the revised estimates are probably an overestimation of deforestation in the country, because they include areas that do not meet the criteria for deforestation under the Kyoto Protocol, but which cannot be quantified at the moment, such as: areas with temporarily limited tree loss where natural regeneration (which is a common practice of forest management in Liechtenstein) is expected, but could not yet be recognized in the aerial photographs at the time the AREA survey was conducted; areas smaller than the minimum area of 625 m^2; and areas with a reduction in forest cover on the grid point of the forest inventory but still fulfilling the Kyoto Protocol definition of forest (i.e. having the potential to reach 3 m at maturity in situ).

103. The ERT considers that the revised estimates (see paras. 101 and 102 above) resolve the issue in the list of potential problems and further questions raised by the ERT during the

review (see paras. 98–100 above). The ERT recommends that Liechtenstein explain in detail the estimation of the areas reported for deforestation in its NIR.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

104. Liechtenstein has reported information on its accounting of Kyoto Protocol units in the required SEF tables, as required by decisions 15/CMP.1 and 14/CMP.1. The ERT took note of the findings included in the standard independent assessment report (SIAR) on the SEF tables and the SEF comparison report.[14] The SIAR was forwarded to the ERT prior to the review, pursuant to decision 16/CP.10. The ERT reiterated the main findings contained in the SIAR.

105. Information on the accounting of Kyoto Protocol units has been prepared and reported in accordance with decision 15/CMP.1, annex, chapter I.E, and reported in accordance with decision 14/CMP.1 using the SEF tables. This information is consistent with that contained in the national registry and with the records of the international transaction log (ITL) and the clean development mechanism registry and meets the requirements referred to in decision 22/CMP.1, annex, paragraph 88(a–j). The transactions of Kyoto Protocol units initiated by the national registry are in accordance with the requirements of the annex to decision 5/CMP.1 and the annex to decision 13/CMP.1. No discrepancy has been identified by the ITL and no non-replacement has occurred. The national registry has adequate procedures in place to minimize discrepancies.

Accounting of activities under Article 3, paragraph 3, of the Kyoto Protocol and any elected activities under Article 3, paragraph 4, of the Kyoto Protocol

106. Liechtenstein has reported information on its accounting of KP-LULUCF in the accounting table, as included in the annex to decision 6/CMP.3. Information on the accounting of KP-LULUCF has been prepared and reported in accordance with decisions 16/CMP.1 and 6/CMP.3.

107. Table 7 shows the accounting quantities for KP-LULUCF as reported by Liechtenstein and the final values after the review.

Table 7
Accounting quantities for activities under Article 3, paragraph 3, and, if any, activities under Article 3, paragraph 4, of the Kyoto Protocol, in t CO_2 eq

	2014 annual submission[a]			*2010, 2011, 2012 and 2013 annual submissions*[b]	*Net accounting quantity*[c]
	As reported	*Revised estimates*	*Final*	*Final*	
Afforestation and reforestation					
Non-harvested land	–978		–978	–813	–165
Harvested land	0		0	0	0
Deforestation	1 709	20 069	20 069	1 319	18 750
Forest management	NA		NA	NA	NA
Article 3.3 offset[d]	NA		NA	NA	NA

[14] The SEF comparison report is prepared by the international transaction log (ITL) administrator and provides information on the outcome of the comparison of data contained in the Party's SEF tables with corresponding records contained in the ITL.

	2014 annual submission[a]			2010, 2011, 2012 and 2013 annual submissions[b]	Net accounting quantity[c]
	As reported	Revised estimates	Final	Final	
Forest management cap[e]	NA		NA	NA	NA
Cropland management	NA		NA	NA	NA
Grazing land management	NA		NA	NA	NA
Revegetation	NA		NA	NA	NA

Abbreviations: CRF = common reporting format, KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NA = not applicable.

[a] The values included under the 2014 annual submission are the cumulative accounting values for 2008, 2009, 2010, 2011 and 2012, as reported in the accounting table of the KP-LULUCF CRF tables for the inventory year 2012.

[b] The values included under the 2010, 2011, 2012 and 2013 submissions are the final accounting values as a result of the 2013 review and are included in table 7 of the 2013 annual review report (FCCC/ARR/2013/LIE, page 28) in the column "2013 annual submission", "Final".

[c] The "net accounting quantity" is the quantity of Kyoto Protocol units that Liechtenstein shall issue or cancel under each activity under Article 3, paragraph 3, and paragraph 4, if relevant, based on the final accounting quantity in the 2014 annual submission and where the quantities issued or cancelled based on the 2013 annual review report have been subtracted ("net accounting quantity" = final 2014 – final 2013 annual review report).

[d] "Article 3.3 offset": for the first commitment period, a Party included in Annex I to the Convention that incurs a net source of emissions under the provisions of Article 3, paragraph 3, of the Kyoto Protocol may account for anthropogenic greenhouse gas emissions by sources and removals by sinks in areas under forest management under Article 3, paragraph 4, up to a level that is equal to the net source of emissions under the provisions of Article 3, paragraph 3, but not greater than 9.0 megatonnes of carbon times five, if the total anthropogenic greenhouse gas emissions by sources and removals by sinks in the managed forest since 1990 is equal to, or larger than, the net source of emissions incurred under Article 3, paragraph 3.

[e] In accordance with decision 16/CMP.1, annex, paragraph 11, for the first commitment period only, additions to and subtractions from the assigned amount of a Party resulting from forest management under Article 3, paragraph 4, of the Kyoto Protocol after the application of decision 16/CMP.1, annex, paragraph 10, and resulting from forest management project activities undertaken under Article 6, shall not exceed the value inscribed in the appendix of the annex to decision 16/CMP.1, times five.

108. Based on the information provided in table 7 for the activity afforestation and reforestation, Liechtenstein shall: for non-harvested land, issue 165 removal units (RMUs) in its national registry; and for harvested land, neither issue nor cancel any units in its national registry.

109. Based on the information provided in table 7 for the activity deforestation, Liechtenstein shall cancel 18,750 assigned amount units, emission reduction units, certified emission reduction units and/or RMUs in its national registry.

Calculation of the commitment period reserve

110. Liechtenstein has reported its commitment period reserve in its 2014 annual submission. Liechtenstein has reported that its commitment period reserve has not changed since the initial report review (950,061 t CO_2 eq) as it is based on the assigned amount and not the most recently reviewed inventory (NIR, section 12.5). The ERT agrees with this figure. Although Liechtenstein submitted revised emission estimates on 3 November 2014 in response to the list of potential problems and further questions raised by the ERT, the value of the commitment period reserve has remained the same.

3. Changes to the national system

111. Liechtenstein reported that there are no changes in its national system since the previous annual submission. The ERT concluded that Liechtenstein's national system

continues to be in accordance with the requirements of national systems outlined in decision 19/CMP.1.

4. Changes to the national registry

112. Liechtenstein reported that there are changes in its national registry since the previous annual submission. Liechtenstein described changes relating to the database structure, conformance to technical standards and test results in its NIR. The ERT concluded that, taking into account the confirmed changes in the national registry, Liechtenstein's national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1 and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP).

5. Minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol

113. Consistent with paragraph 23 of the annex to decision 15/CMP.1, Liechtenstein provided information relating to how it is striving, under Article 3, paragraph 14, of the Kyoto Protocol, to implement its commitments in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention.

114. Liechtenstein's reporting of activities to minimize the adverse impacts of response measures includes, as already reported in the previous submission: policies and measures developed in order to avoid trade distortion and non-tariff barriers to trade; the limitation of tax exemption for biofuels to biofuels that meet ecological and social criteria; and a project by the Swiss Academies of Arts and Sciences initiated to assess possible conflicts and synergies between the expansion of renewable energy production and land management.

115. In response a question raised by the ERT during the review, Liechtenstein provided information on how it gives priority to the actions listed in paragraphs 24(a) and (b) of the annex to decision 15/CMP.1 in implementing its commitments under Article 3, paragraph 1, of the Kyoto Protocol. The ERT recommends that Liechtenstein include this information in its next NIR.

116. Liechtenstein did not provide information on changes in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol in its annual submission. However, the ERT identified that there are changes in its reporting under Article 3, paragraph 14. Liechtenstein included in its 2014 submission a short description of the document *The Energy Strategy 2020*, adopted by the Government of Liechtenstein in 2012, mentioning that this document addresses the need to minimize adverse effects of its proposed measures as required by Article 3, paragraph 14 of the Kyoto Protocol. The ERT concluded that, taking into account the confirmed changes in the reporting, the information provided is complete and transparent. The ERT recommends that Liechtenstein, in its annual submission, report any changes in its information provided under Article 3, paragraph 14, in accordance with decision 15/CMP.1, annex, chapter I.H.

III. Conclusions and recommendations

A. Conclusions

117. Table 8 summarizes the ERT's conclusions on the 2014 annual submission of Liechtenstein, in accordance with the Article 8 review guidelines.

Table 8
Expert review team's conclusions on the 2014 annual submission of Liechtenstein

Issue	*Expert review team assessment*	*Paragraph cross-references*
The ERT concludes that the inventory submission of Liechtenstein is complete with regard to categories, gases, years and geographical boundaries and contains both an NIR and CRF tables for 1990–2012		
Annex A sources[a]	Complete	
LULUCF[a]	Complete	
KP-LULUCF	Complete	
The ERT concludes that the inventory submission of Liechtenstein has been prepared and reported in accordance with the UNFCCC reporting guidelines	Generally	See table 5 above
Liechtenstein's inventory is in accordance with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF	Generally	See table 4 and paras. 53, 82, 84, 96 and 97 above
The submission of information required under Article 7, paragraph 1, of the Kyoto Protocol has been prepared and reported in accordance with decision 15/CMP.1	Yes	
Liechtenstein has reported information on its accounting of Kyoto Protocol units in accordance with decision 15/CMP.1, annex, chapter I.E, and used the required reporting format tables as specified by decision 14/CMP.1	Yes	
The national system continues to perform its required functions as set out in the annex to decision 19/CMP.1	Yes	
The national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1 and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant CMP decisions	Yes	
Did Liechtenstein provide information in the NIR on changes in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol?	No	See para. 116 above

Abbreviations: Annex A sources = source categories included in Annex A to the Kyoto Protocol, CMP = Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol, CRF = common reporting format, ERT = expert review team, IPCC = Intergovernmental Panel on Climate Change, IPCC good practice guidance = IPCC *Good Practice Guidance and*

Uncertainty Management in National Greenhouse Gas Inventories, IPCC good practice guidance for LULUCF = IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*, KP-LULUCF = LULUCF emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, LULUCF = land use, land-use change and forestry, NIR = national inventory report, Revised 1996 IPCC Guidelines = *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, UNFCCC reporting guidelines = "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories".

[a] The assessment of completeness by the ERT considers only the completeness of reporting of mandatory categories (i.e. categories for which methods and default emission factors are provided in the Revised 1996 IPCC Guidelines, the IPCC good practice guidance or the IPCC good practice guidance for LULUCF).

B. Recommendations

118. The ERT identified the issues for improvement listed in table 9. All recommendations are for the next annual submission, unless otherwise specified. Where recommendations cannot be fully implemented in time for the 2015 annual submission, the ERT recommends that Liechtenstein provide an update on progress of implementation in the NIR.

Table 9
Recommendations identified by the expert review team

Sector	*Category/cross-cutting issue*	*Recommendation*	*Reiteration of previous recommendation?*	*Paragraph cross-references*
Cross-cutting	Recalculations	Provide the impact of the recalculations at the key category level in chapter 10 of the NIR	No	Table 3
	QA/QC	Include the findings of the implemented reviews in the NIR	No	12
		Correct the errors and discrepancies identified and implement additional QC procedures to avoid errors or discrepancies between the CRF tables and the NIR	No	26, 32, 69
	Inventory planning	Revise the improvement development plan	Yes	14
	Key category analysis	Consistently apply the approach set out in the IPCC good practice guidance	No	17
		Remove activities under Article 3, paragraph 4, of the Kyoto Protocol from the key category analysis	No	Table 4
Energy	International bunker fuels	Determine the share between domestic and international aviation for the years of the 2003–2011 period based on data collected in 2002 and 2012	No	31
	Feedstocks and non-energy use of fuels	Report lubricants and bitumen use in CRF tables 1.A(b) and 1.A(d) for the entire time series, including the use of lubricants used for two-stroke engines	Yes	33
	Stationary combustion: liquid and gaseous fuels – CO_2, CH_4 and N_2O	Incorporate all the information on electricity production provided during the review in the NIR	Yes	35
		Update the description of the allocation of fuel consumption and emissions from construction and industrial off-road machinery in the NIR	No	37

Sector	*Category/cross-cutting issue*	*Recommendation*	*Reiteration of previous recommendation?*	*Paragraph cross-references*
		Report military emissions as "NO" and explain that there are no military activities in the country	No	38
		Improve the transparency of the information on the allocation of emissions from off-road vehicles in construction and industry	No	39
		Review with the two operators the confidentiality of the emission estimates and AD for food processing, beverages and tobacco	No	41
		Reallocate the emissions to the correct categories (food processing, beverages and tobacco or other (manufacturing industries and construction))	No	41
	Road transportation: liquid fuels – CO_2	Report lubricants use separately from fuel consumption in the next submission	No	42
		Revise the information in the NIR on biofuels used to clarify the explanation and make it consistent with the information reported in the CRF tables	No	44
	Other transportation: liquid fuels – CO_2, CH_4 and N_2O	Include in the NIR the information that neither fuel consumption by the equipment supporting the pipeline transportation activities of natural gas, nor ground activities in airports are occurring in Liechtenstein	No	47
	Oil and natural gas – CH_4	Explain in detail the methodology used, and provide and reference in the NIR all the AD and parameters used; report CH_4 emissions from natural gas distribution activities separately from the CH_4 emissions from other leakage of natural gas activities (losses at the services end-user)	No	50
Industrial processes and solvent and other product use	Consumption of halocarbons and SF_6 – HFCs, PFCs and SF_6	Exclude the emissions from manufacture in the estimates for emissions from refrigeration and air-conditioning equipment, and assess how the accuracy of the estimation of emissions from disposal can be improved to avoid overestimating these emissions	No	53
		Correct the explanation of the trend for HFC emissions	No	55
Agriculture	Transparency	Include all information on drivers of emission trends and on country-specific data	No	61
		Include detailed explanatory information on "animal place" and the estimation of Nex in the NIR	No	63
	QC	Include the comparison analysis of national and other data sources in the QC checklist and report on the results on an annual basis	No	62
	Enteric fermentation –	Include a table with the parameters used to estimate gross energy for cattle in the NIR	No	64

Sector	*Category/cross-cutting issue*	*Recommendation*	*Reiteration of previous recommendation?*	*Paragraph cross-references*
	CH_4	Replace notation keys with numerical data in the additional information table to CRF table 4.A where it is appropriate or justify the use of notation keys in footnotes or documentation boxes to CRF table 4.A	No	65
		Include the information on methane conversion rates for mature and young cattle in the NIR and in the documentation box to CRF table 4.A	No	66
	Manure management – CH_4 and N_2O	Explain the methodological changes in the estimation of N_2O emissions from manure management of cattle and swine; investigate the possibility of gathering country-specific AWMS data	No	68
		Replace the notation key "NE" reported for typical animal mass of mature dairy and non-dairy cattle in CRF table 4.B(a) with the values reported in CRF table 4.A	No	69
		Report the fractions of manure per AWMS that do not occur as "NO"	No	70
	Direct soil emissions – N_2O	Include in the NIR information about factors that influenced the sharp increase in emissions from nitrogen-fixing crops in 2011	No	71
		Refer to the regulation that prohibits the use of sewage sludge as fertilizer since 2004	No	72
	Field burning of agricultural residues – CH_4 and N_2O	For field burning of agricultural residues, report AD and emissions as "NO" and the IEF as "NA" in CRF table 4.F	No	73
LULUCF	Transparency	Improve the descriptions of the methodology for estimating uncertainties and the reporting of the uncertainty values in the NIR	No	77
	Forest land remaining forest land – CO_2	For gross biomass growth, harvest and mortality rates, apply data from the most recent Swiss NFI after checking that these data are applicable to the circumstances in Liechtenstein, or collect additional country-specific data	No	78
		For estimating carbon stock changes in the deadwood pool, apply data from the most recent Swiss NFI, which may be more relevant for the most recent periods in the estimation of accurate data, or collect additional country-specific data, and report on the methodology used	No	79
		Explain in the NIR that the reported wood density values are basic density values	No	80
	Land converted to forest land – CO_2	Include the information provided during the review on how harvests and mortality were numerically taken into account in the stock values	No	81

Sector	*Category/cross-cutting issue*	*Recommendation*	*Reiteration of previous recommendation?*	*Paragraph cross-references*
		Improve the description of the methodology to estimate carbon stock changes in mineral and organic soils in land converted to forest land in the NIR	No	82
		Report afforestation under the category land converted to forest land rather than the category forest land remaining forest land; explain this recalculation in the NIR and move the information to the appropriate chapter	No	83
	Grassland remaining grassland – CO_2	Include, in the NIR, a more detailed justification regarding the subcategories used by the Party, which represent carbon stocks and dynamics of grasslands better than those of croplands, or use the categorization as indicated in the IPCC good practice guidance for LULUCF	No	84
Waste	Sector overview	Undertake an evaluation to ensure that the methods, parameters and other data provided in the inventory submission are applicable to the national circumstances of Liechtenstein and document these checks	No	88
	Uncertainty analysis	Provide quantitative uncertainty estimates for all waste categories and discuss the reasons for the estimates in the appropriate section in the waste chapter of the NIR	No	89
	Solid waste disposal on land – CH_4	Explain the methodological changes in the estimation of CH_4 emissions from solid waste disposal on land	No	92
Activities under Article 3, paragraph 3, of the Kyoto Protocol	Deforestation – CO_2	Explain in detail the estimation of the areas for deforestation in the NIR	No	103
Article 3, paragraph 14, of the Kyoto Protocol	General	Include the information provided during the review on how Liechtenstein gives priority to the actions listed in paragraphs 24(a) and (b) of the annex to decision 15/CMP.1 in implementing its commitments under Article 3, paragraph 1, of the Kyoto Protocol	No	115
		Report any changes in the information provided under Article 3, paragraph 14	No	116
Cross-cutting	General	Provide an update on progress of implementation of the recommendations in the NIR	No	118

Abbreviations: AD = activity data, AWMS = animal waste management system, CRF = common reporting format, IPCC = Intergovernmental Panel on Climate Change, IPCC good practice guidance = IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, IPCC good practice guidance for LULUCF = IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry*, LULUCF = land use, land-use change and forestry, NA = not applicable, NE = not estimated, Nex = nitrogen excretion, NFI = national forest inventory, NIR = national inventory report, NO = not occurring, QA/QC = quality assurance/quality control.

IV. Questions of implementation

119. No questions of implementation were identified by the ERT during the review.

Annex I

Information to be included in the compilation and accounting database

Table 10
Information to be included in the compilation and accounting database in t CO_2 eq for 2012, including the commitment period reserve

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Commitment period reserve	950 061			950 061
Annex A emissions for 2012				
CO_2	188 560			188 560
CH_4	15 754	15 884		15 884
N_2O	12 708	12 477		12 477
HFCs	8 328			8 328
PFCs	48			48
SF_6	0			0
Total Annex A sources[c]	**225 399**	**225 298**		**225 298**
Activities under Article 3, paragraph 3, for 2012				
3.3 Afforestation and reforestation on non-harvested land for 2012	−165			−165
3.3 Afforestation and reforestation on harvested land for 2012	0			0
3.3 Deforestation for 2012	390	4 130		4 130
Activities under Article 3, paragraph 4, for 2012[d]				
3.4 Forest management for 2012				
3.4 Cropland management for 2012				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2012				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2012				
3.4 Revegetation for the base year				

Abbreviations: Annex A sources = source categories included in Annex A to the Kyoto Protocol.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] The values for "Total Annex A sources" in the columns "As reported", "Revised estimates" and "Final" may not equal the sum of the values of the gases in those columns owing to rounding.
[d] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 11
Information to be included in the compilation and accounting database in t CO_2 eq for 2011

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2011				
CO_2	179 995			179 995
CH_4	15 426	15 557		15 557
N_2O	12 740	12 524		12 524
HFCs	7 976			7 976
PFCs	55			55
SF_6	14			14
Total Annex A sources[c]	**216 207**	**216 121**		**216 121**
Activities under Article 3, paragraph 3, for 2011				
3.3 Afforestation and reforestation on non-harvested land for 2011	−182			−182
3.3 Afforestation and reforestation on harvested land for 2011	0			0
3.3 Deforestation for 2011	393	4 067		4 067
Activities under Article 3, paragraph 4, for 2011[d]				
3.4 Forest management for 2011				
3.4 Cropland management for 2011				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2011				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2011				
3.4 Revegetation for the base year				

Abbreviations: Annex A sources = source categories included in Annex A to the Kyoto Protocol.

[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).

[b] "Final" includes revised estimates, if any, and/or adjustments, if any.

[c] The values for "Total Annex A sources" in the columns "As reported", "Revised estimates" and "Final" may not equal the sum of the values for the gases in those columns owing to rounding.

[d] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 12
Information to be included in the compilation and accounting database in t CO_2 eq for 2010

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2010				
CO_2	194 122			194 122
CH_4	15 058	15 191		15 191
N_2O	12 565	12 361		12 361
HFCs	7 873			7 873
PFCs	62			62
SF_6	25			25
Total Annex A sources[c]	**229 705**	**229 633**		**229 633**
Activities under Article 3, paragraph 3, for 2010				
3.3 Afforestation and reforestation on non-harvested land for 2010	–199			–199
3.3 Afforestation and reforestation on harvested land for 2010	0			0
3.3 Deforestation for 2010	143	4 012		4 012
Activities under Article 3, paragraph 4, for 2010[d]				
3.4 Forest management for 2010				
3.4 Cropland management for 2010				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2010				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2010				
3.4 Revegetation for the base year				

Abbreviations: Annex A sources = source categories included in Annex A to the Kyoto Protocol.

[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).

[b] "Final" includes revised estimates, if any, and/or adjustments, if any.

[c] The values for "Total Annex A sources" in the columns "As reported", "Revised estimates" and "Final" may not equal the sum of the values for the gases in those columns owing to rounding.

[d] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 13
Information to be included in the compilation and accounting database in t CO_2 eq for 2009

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2009				
CO_2	209 013			209 013
CH_4	15 475	15 614		15 614
N_2O	12 613	12 398		12 398
HFCs	7 431			7 431
PFCs	64			64
SF_6	142			142
Total Annex A sources[c]	**244 738**	**244 663**		**244 663**
Activities under Article 3, paragraph 3, for 2009				
3.3 Afforestation and reforestation on non-harvested land for 2009	–217			–217
3.3 Afforestation and reforestation on harvested land for 2009	0			0
3.3 Deforestation for 2009	433	3 957		3 957
Activities under Article 3, paragraph 4, for 2009[d]				
3.4 Forest management for 2009				
3.4 Cropland management for 2009				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2009				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2009				
3.4 Revegetation for the base year				

Abbreviations: Annex A sources = source categories included in Annex A to the Kyoto Protocol.

[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).

[b] "Final" includes revised estimates, if any, and/or adjustments, if any.

[c] The values for "Total Annex A sources" in the columns "As reported", "Revised estimates" and "Final" may not equal the sum of the values for the gases in those columns owing to rounding.

[d] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 14
Information to be included in the compilation and accounting database in t CO_2 eq for 2008

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2008				
CO_2	223 345			223 345
CH_4	15 743	15 890		15 890
N_2O	12 792	12 538		12 538
HFCs	7 191			7 191
PFCs	66			66
SF_6	363			363
Total Annex A sources[c]	**259 500**	**259 394**		**259 394**
Activities under Article 3, paragraph 3, for 2008				
3.3 Afforestation and reforestation on non-harvested land for 2008	–215			–215
3.3 Afforestation and reforestation on harvested land for 2008	0			0
3.3 Deforestation for 2008	350	3 902		3 902
Activities under Article 3, paragraph 4, for 2008[d]				
3.4 Forest management for 2008				
3.4 Cropland management for 2008				
3.4 Cropland management for the base year				
3.4 Grazing land management for 2008				
3.4 Grazing land management for the base year				
3.4 Revegetation for 2008				
3.4 Revegetation for the base year				

Abbreviations: Annex A sources = source categories included in Annex A to the Kyoto Protocol.

[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).

[b] "Final" includes revised estimates, if any, and/or adjustments, if any.

[c] The values for "Total Annex A sources" in the columns "As reported", "Revised estimates" and "Final" may not equal the sum of the values for the gases in those columns owing to rounding.

[d] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Annex II

Documents and information used during the review

A. Reference documents

Intergovernmental Panel on Climate Change. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Available at <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>.

Intergovernmental Panel on Climate Change. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. Available at <http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>.

Intergovernmental Panel on Climate Change. *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Available at <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.

Intergovernmental Panel on Climate Change. *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. Available at <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>.

"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories". FCCC/SBSTA/2006/9. Available at <http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf>.

"Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention". FCCC/CP/2002/8. Available at <http://unfccc.int/resource/docs/cop8/08.pdf>.

"Guidelines for national systems for the estimation of anthropogenic greenhouse gas emissions by sources and removals by sinks under Article 5, paragraph 1, of the Kyoto Protocol". Decision 19/CMP.1. Available at <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf#page=14>.

"Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol". Decision 15/CMP.1. Available at <http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf#page=54>.

"Guidelines for review under Article 8 of the Kyoto Protocol". Decision 22/CMP.1. Available at <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf#page=51>.

Status report for Liechtenstein 2014. Available at <http://unfccc.int/resource/docs/2014/asr/lie.pdf>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2014. Available at <http://unfccc.int/resource/webdocs/sai/2014.pdf>.

FCCC/ARR/2013/LIE. Report of the individual review of the annual submission of Liechtenstein submitted in 2013. Available at <http://unfccc.int/resource/docs/2014/arr/lie.pdf>.

Standard independent assessment report template, parts 1 and 2. Available at <http://unfccc.int/kyoto_protocol/registry_systems/independent_assessment_reports/items/4061.php>.

B. Additional information provided by Liechtenstein

Responses to questions during the review were received from Ms. Heike Summer (Office of Environment), including additional material on the methodology and assumptions used. The following documents[1] were also provided by Liechtenstein:

Bretscher D and Kupper T. 2012. *Categorization of Livestock Animals in Switzerland.* Reckenholz-Tänikon Research Station ART, Zurich: Agroscope.

[1] Reproduced as received from the Party.

Annex III

Acronyms and abbreviations

AD	activity data
AWMS	animal waste management system
CH_4	methane
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CRF	common reporting format
EF	emission factor
ERT	expert review team
EU ETS	European Union Emissions Trading System
GE	gross energy
GHG	greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 without GHG emissions and removals from LULUCF
HFCs	hydrofluorocarbons
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
ITL	international transaction log
k	methane generation rate constant
kha	kilohectare
kg	kilogram (1 kg = 1,000 grams)
KP-LULUCF	land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
LULUCF	land use, land-use change and forestry
m^3	cubic metre
MCF	methane conversion factor
N_2O	nitrous oxide
N	nitrogen
Nex	nitrogen excretion
NFI	national forest inventory
NA	not applicable
NE	not estimated
NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
PJ	petajoule (1 PJ = 10^{15} joule)
QA/QC	quality assurance/quality control
RMU	removal unit
SEF	standard electronic format
SF_6	sulphur hexafluoride
SIAR	standard independent assessment report
UNFCCC	United Nations Framework Convention on Climate Change
VS	volatile solids